Psychological Conceptions in Other Sciences

BY

CHARLES S. MYERS, C.B.E., F.R.S.
M.A., M.D., Sc.D. (Camb.)
Hon. D.Sc. (Manch.)

The

Herbert Spencer Lecture

DELIVERED AT OXFORD

14 MAY, 1929

OXFORD
AT THE CLARENDON PRESS
1929

Psychological Conceptions in Other Sciences

BY

CHARLES S. MYERS, C.B.E., F.R.S.
M.A., M.D., Sc.D. (Camb.)
Hon. D.Sc. (Manch.)

The

Herbert Spencer Lecture

Delivered at Oxford

14 May, 1929

OXFORD
AT THE CLARENDON PRESS
1929

ARGUMENT

AN attempt is here made to ascertain whether certain principles, conceptions, and attitudes which have been adopted and developed by Psychology may not prove common or helpful to other Sciences. This attempt implies a reversal of the usual practice of describing the 'higher' Sciences in the languages of the 'lower'. It is also contrary to the standpoint assumed by those who believe in the 'emergence' of totally new principles in passing, say, from Physics to Biology or from Biology to Psychology.

The psychologist tends rather to regard the new as already existing, however imperfectly, in the old. In his attitude to Evolution, he lays less stress on the aggregation of simpler parts to form a more heterogeneous whole, than on the differentiation of new parts out of a developing whole. A similar attitude is finding favour with biologists in regard to the evolution of hereditary units and of bodily structures and functions. For the psychologist Evolution consists rather in the distillation of what has pre-existed vaguely in the *apparently* simpler (because undifferentiated) organism: the more 'composite' products, e.g. music, language, or the perception of objects, precede the more 'elementary' (because abstract), e.g. scales, grammar, or the awareness of 'pure' sensations. From a similar attitude proceeds the psychologist's insistence that the organized whole is always greater than the sum of its parts.

There is a growing belief among physicists that it is impossible to predict what an *individual* atom or electron will do, or which of the possible jumps of a quantum will occur next: the laws of Physics are now believed to be derived from, and to be applicable only to, the *average* conduct of *huge aggregates* of individuals. Intent on the study of the *individual* and of the differences between individuals, the psychologist has long found mechanism everywhere, yet prediction impossible largely owing to directive guidance within the individual organism. For him conservation of the individual—making for endurance of identity and for

perpetuation of pattern—is as important a principle as conservation of matter or conservation of energy. Recognition of this principle, together with the limitations of mechanical determinism, may well extend beyond Biology to Physics.

From its own outlook Psychology has long insisted on the subjectivity and relativity of space, time, movement, weight, &c. As regards their reality and absoluteness, Psychology finds itself unable to distinguish between these once-called 'primary' qualities and the 'secondary' qualities of objects (colour, sound, taste, smell, &c.). Correspondingly, physical theory is fast abandoning its former notions of substance and absoluteness: it is becoming occupied rather in the study of geometrical structure and mathematical relations of certain entities which are themselves unknowable and unimaginable.

The once striking characteristics distinguishing Matter from Mind are fading rapidly. Mind appears to be no more 'unsubstantial' than Matter; Matter to be no more 'predictable' than Mind. To account for the Evolution, the history and conduct, of the Universe, or of any organized individual within the Universe, whether relating to Mind, Life, or Matter, not only mechanical principles but also a certain adapting, selecting, guiding activity must ultimately be included among the *First Principles* of Science.

PSYCHOLOGICAL CONCEPTIONS IN OTHER SCIENCES

IN the course of this Lecture I shall have occasion to stress the impossibility of predicting the coming actions or experience of an organized unit or individual; and in my opening words I cannot refrain from giving a personal illustration of this impossibility. Thirty-five years ago, when an undergraduate at Cambridge, I was asked by my tutor to name the books that would be most welcome to me for a College prize which I had gained; and with the enthusiasm of youth for a revered author, I chose at once the works of Herbert Spencer. At that time no one would have been so rash as to predict—and I should myself have most strenuously denied—the possibility that some day my sister University would pay me the signal honour of inviting me to deliver one of the series of annual lectures since established in memory of that distinguished philosopher.

Distinguished Spencer will always be for his courageous effort to embrace in one vast descriptive scheme the principles underlying the evolution of the Universe—of Mind and Nature. Whether he was right in supposing, whether he really did suppose, that Evolution runs on purely mechanical lines, and that the same mechanical principles can suffice to describe the history and characteristics of lifeless and living matter, and of mind and of social institutions, may be open to doubt. But in Spencer's time there was a naïve faith in the universality and permanence of the conceptions of Physics. His relatively simple philosophical system may be regarded as an inevitable expression of that age of innocence and pride. Since then those beliefs and hopes have suffered rude shocks. To-day, indeed, it is widely doubted whether conceptions derived from the study of 'lower' phenomena are sufficient to explain 'higher' phenomena—whether new principles do not emerge and engage as we pass from Physics to Biology, from Biology to Psychology, from Psychology to Sociology.

We no longer feel so satisfied that adequate light is thrown on the nature and significance of Evolution by such Spencerian phrases as the passage from homogeneity to heterogeneity, or the change from incoherence to coherence or from indefiniteness to definiteness; or that any real assistance is rendered by drawing analogies between the cells, or the circulatory, nervous, and other systems of more complex living organisms, on the one hand, and the structure of advanced human societies, on the other.

In Spencer's time the philosophical problem presented itself usually in the form of a dilemma—Are we to express 'mechanical' Motion in terms of 'spiritual' Mind, or 'spiritual' Mind in terms of 'mechanical' Motion? Spencer fully realized that both the objective activity of Matter and the subjective activity of Mind are unknowable, and that we can only describe them by the use of symbols. He has recorded his conviction that behind Mind and Matter lies one and the same Power manifesting itself to us as both. We see, then, he says, 'that the whole question is at last nothing more than the question whether these symbols should be expressed in terms of those or those in terms of these—a question', he curiously adds, 'scarcely worth deciding'.[1] But he did decide; and most of Spencer's work arose out of his determination to interpret all phenomena in terms of matter and motion. Despite this determination, he confessed that 'it seems easier to translate so-called Matter into so-called Spirit, than to translate so-called Spirit into so-called Matter'.[2] And despite this determination he realized that 'Matter and Motion are concretes built up from the contents of various mental relations'.[3] Indeed he admitted that our experiences of Matter and Motion are resolvable into and constructed out of our experiences of Force, and that our experiences of Force are unique and ultimate, not derivable from anything else.[4] Our self-activity becomes thus for Spencer the fundamental source of our conceptions of Matter and Motion.

[1] Cf. *Principles of Psychology*, vol. i, p. 159.

[2] Ibid., p. 161.

[3] *First Principles*, p. 169.

[4] Ibid., pp. 167, 169.

These conclusions form the starting-point of this Lecture. Instead, on the one hand, of adopting Spencer's procedure of attempting to describe the apparently complex in terms of the apparently simple; instead, on the other hand, of resting content with the supposition that entirely new principles emerge as we pass from lower-level to higher-level systems of activity within the Universe, I propose to ascertain whether some of those 'higher' principles are not, however vaguely, already recognizable at lower levels. I propose, in fact, to consider how far our knowledge of the mental world is helpfully applicable to the material world, how far conceptions and attitudes which have been specially employed and developed by Psychology may also prove—or have also proved—useful and common to other Sciences.

At one time it was usual to distinguish 'primary' and 'secondary' qualities in objects. The secondary qualities, e.g. those of colour, sound, smell, taste, and temperature, were regarded as purely subjective, due to stimulation of some appropriate sense organ. On the other hand, the primary qualities, e.g. those of size, shape, hardness, movement, and weight, were held to be independent of the sense organs through which they were experienced. They were the 'real' properties of matter; and so long as the physicist regarded them as such, the philosopher naturally tended to rest content. Not so, however, the psychologist. By him the primary qualities have long been regarded as not a whit more real than the secondary. Even Spencer in his day fully recognized—'What we are conscious of as properties of matter, even down to its weight and resistance, are but subjective affections produced by objective agencies that are unknown and unknowable . . . symbols of actions out of ourselves, the natures of which we cannot even conceive.'[1] For him not only Matter and Motion but also Space and Time are derivable from 'mental relations'.[2] The physicist has been fast approaching a similar point of view, discarding, one by one, conceptions (which were

[1] *Principles of Psychology*, vol. i, p. 206.
[2] *First Principles*, p. 169.

once crudely accepted as ultimate realities) of force, mass, inertia, gravitation, &c.

It has also long been recognized by the psychologist that there is nothing 'absolute' about the conscious products of mental activity: they are 'relative' both to the present conditions of mental activity and to the past experiences of the experient. 'A Crustacean,' said Spencer, 'everywhere enclosed in a hard exo-skeleton, can have no such tactual impressions as those which are possible to a soft-skinned animal. The impressions received from the ends of its limbs and claws when they come into contact with external objects, may be compared to those which a man receives from poking objects with the end of his walking stick.' And, he adds, 'various aquatic creatures that have undeveloped organs of Hearing, are nevertheless affected by those vibrations which to creatures better endowed are sonorous . . . the quality of the feeling excited in these lower animals by sonorous waves, is wholly unlike the quality of the feelings which such waves excite in higher animals.'[1]

The same holds good, as Spencer also pointed out, for spatial and temporal experiences. 'Animals having great locomotive powers are not likely to have the same conceptions of given spaces as animals whose locomotive powers are very small.'[2] It is likewise 'impossible to suppose equality between an interval of time as present to consciousness and any nexus of things which it symbolizes'.[3] Psychological experiment and common observation prove that our estimate of time varies according as it is filled or empty, and according as we are pleasantly occupied or monotonously bored during the interval. The apparent order of two exactly or nearly simultaneous stimuli has been shown to be dependent on the direction of our attention to the one or to the other of them at the moment of their reception.

So too our estimate of space, whether afforded by sight or by touch, varies according as it is filled or empty, and

[1] *Principles of Psychology*, vol. i, p. 195.
[2] Ibid., p. 212. [3] Ibid., p. 219.

our visual estimate of the length and direction of lines varies according to the presence of other lines presented simultaneously with them. The estimated distance between two points applied simultaneously to our skin differs in different regions of the body surface, recalling the difference which Spencer indicated between the tactual impressions of the Crustacean and those of Man. The appreciation of movement when a blindfold person is passively rotated or moved in a straight line depends not on the absolute speed of the movement but on the change of speed of movement. The old aphorism, *semper idem sentire ac non sentire idem est,* proclaims a deep and wide truth.

Our estimation of the weight of an object is found to vary with the speed with which we happen to lift it, and hence often with the object's size whether judged by grasp or by vision. For example, a pound box full of feathers when lifted appears to weigh less than a pound box full of lead, because the box of feathers, being by far the larger, inevitably evokes a bigger lifting effort, rises therefore more rapidly, and hence appears to be lighter, than the smaller, but in fact equally heavy, box full of lead.

Our appreciation of colour is modified by successive or simultaneous contrast. That is to say, the effect of any colour stimulus upon a given area of the retina is determined by the manner and result of previous stimulation of that area and by simultaneous stimulation of neighbouring retinal areas. Everywhere, indeed, within his field of study the psychologist has insisted on the importance of relativity at a time when the physicist was considering that his subject, and indeed that all Natural Science, depended on the retention of the absolute.

On two occasions at least in its history, Psychology has suffered by the incursions of physicists who endeavoured to replace the relative there by the absolute. When a grey strip is placed on a uniformly coloured (e.g. red) background and the whole is covered with a piece of tissue paper, the grey strip assumes a colour (green) complementary to that of the background. Helmholtz supposed that this was due

(*a*) to our regarding the now green strip as coming through from behind the red background, and (*b*) to our previous experience that for a grey strip to be seen through a red background it must in reality be green. That is to say, he ascribed the greenish colour of the really grey strip to an interpretation based on false inference of its position and on past experience.

We now know from an abundance of other evidence that it is the contrast colour which is primary and sensory, and that what is secondary and interpreted is not, as Helmholtz supposed, the awareness of the contrast colour in the grey strip, but its neglect. Through experience we discount, we do not produce, the contrast colour. It takes an artist to return to sensory innocence—to paint things as they were before interpretation substituted the absolute for the relative. Only the artist can fully appreciate the blueness of shadows on a yellow ground or their greenness on a red ground. The ordinary man conquers his native, naïve, relativism; he 'knows' that a shadow is grey or black, and accordingly he 'sees' it as such. He 'knows' that a snow mountain is white; and he 'sees' it as such, to a large extent regardless of the coloured light by which it may happen to be illumined. One has only to look through a cardboard tube at the shadow of an object cast in daylight by a candle on a white sheet of paper, to realize its surprising blueness; or to view through such a tube a snow mountain at sunset, to appreciate the wonderful, otherwise imperfectly recognized, depth of its redness. It is the relative that is primary and innate, and the absolute that is secondary and acquired. Helmholtz sought to reverse this statement in colour vision.

Just as there is nothing absolute in our spatial or temporal experience or in the quality of our sensations, so there is nothing absolute in the intensity of the latter. We cannot estimate in terms of its stimulus the absolute intensity of any sensation. All that we can say is what Weber in his well-known law declared, that the *difference* in intensity between two sensations depends on the ratio which the difference between the strength of their corresponding

stimuli bears to that strength. We cannot, save indirectly, judge that one sensation has twice or half the intensity of another. All that we can say in the comparison of intensities of sensations is that one is equal to, greater than, or less than another, or that the difference in intensity between one pair of sensations is equal to, greater than, or less than the difference between a second pair. We can no more add together two sensations of different intensity than we can add together two pleasures or pains.

But by methods which depended on purely mathematical and apparently logical manipulations, but were wholly unwarranted and contradicted by psychological considerations, the physicist Fechner claimed to prove that the absolute intensity of one sensation could be compared with that of another and that it is proportional to the logarithm of the strength of its stimulus. Here we have a second example of the vain attempt of the physicist to replace the relative by the absolute in psychology.

It is perhaps idle to ask whether, if Physics had been willing to learn a lesson from Psychology, instead of trying to teach it one, its present position might have been sooner reached. We now find Newton's absolute time and absolute space discarded and replaced by concepts of relativity. There is now for physicists no absolute location of objects in space: their location varies with, and is relative to, the surrounding frame of space. Time is now inferred to run more slowly in such a place as the sun than with us, because the sun's mass is greater than that of the earth. Regarded as a mathematical point, an instant of time has vanished for the physicist: the psychologist's conception of the enduring 'specious present' seems to be replacing it. And the question has been lately raised whether matter itself is not for the physicist merely the way in which our minds perceive certain aspects of its structure.

Indeed Physics is now largely engaged in dealing with geometrical structure rather than with material substance. Substance, which was once supposed to distinguish Matter so clearly from Mind, has gone from electrons, quanta, and

ether. What are primarily sought now are the mathematical relations in terms of which the Universe can be described. Not only the ether, but also electrons and quanta are unimaginable and unknowable entities. They are no longer modelled on what we know in the 'big world'; the electron may indeed be subject to change in the very act of becoming known to us. They are—to use Spencer's words again—'symbols of actions out of ourselves, the natures of which we cannot even conceive', except—we might in these days add—by applying a non-Euclidean geometry to the purely mathematical conception of a space-time continuum. In erecting such a four-dimensional structure, how far are we removed from the simple, naïve standpoint assumed by Lord Kelvin, when he said, 'I never satisfy myself till I can make a mechanical model of a thing. If I can make a mechanical model, I can understand it. As long as I cannot make a mechanical model all the way through, I cannot understand, and that is why I cannot get the electro-magnetic theory of light?'[1] In Lord Kelvin's time the ether was regarded as material—as a sublimed kind of matter. He felt himself therefore able to declare of it—'That is the only substance we are confident of in dynamics. One thing we are sure of, and that is the reality and substantiality of the luminiferous ether.'[2] Few physicists would speak to-day with such confidence about what they are sure of, when 'realities' and 'substantialities' are being shattered in such succession and profusion, and the Universe seems scientifically coming to be regarded as a vast corpus of mathematical necessities and possibilities, certain of which, as expressed for example in the laws of mechanics, gravitation, &c., through the further operation of mind become 'physical'.

The domain of Physics has not only been deprived of substance and absoluteness: it is also relinquishing its claim to being solely swayed by determinism. Deal with

[1] *Nature*, 1885, vol. xxxi, p. 603.

[2] *Popular Lectures and Addresses* (London: Macmillan & Co., 1889), vol. i, p. 310.

the average conduct of individuals *en masse*—and prediction is relatively easy. Destroy the characteristics of the individual and deal with its isolated, abstract parts—and again the general notion of a machine may, for practical purposes, suffice. But Psychology is concerned primarily with the intact *individual* organism; and while it fully recognizes the play of 'mechanism', it has at the same time been compelled through the very nature of its study also to recognize 'direction' as a characteristic of each whole individual system, over and above the mechanical characteristics better visible in its abstract parts or in a chaotic medley of such individual systems.

There was a time in the history of Psychology, before it had obtained its independence from Philosophy, when it was chiefly valued and used by the philosopher to support his own metaphysical views, and when each philosopher thought he could justifiably generalize on psychological problems merely from an introspective examination of his own mental processes. He supposed that all minds were virtually the same—that they consisted only of a small number of faculties differing little in degree in different individuals. Psychology now recognizes that the number of individually different mental characters is enormous, and that the total resulting differences are so vast as to produce the apparent effect that individual minds differ not merely in degree but in kind. Psychology is not primarily concerned in determining the *average* threshold, the *average* memory, the *average* imagery, the *average* emotionality, the *average* conduct of an unorganized mass of individuals under given conditions. Its primary interests lie in the study of the *individual* and in the study of the *differences* between individuals. For Psychology average statements, mean values, correlation coefficients and the like, are a mere blur or blind to individual differences; the average may well be but a statistical figment having solely abstract value.

In Physics and Chemistry attention has only in recent years begun to be paid to the study of the individual and of individual differences. Physicists and chemists are no

longer content to share Clerk Maxwell's belief in the regularity and uniformity of minute units of matter, or his satisfaction with such regularity and uniformity as being indicative of that spirit of order in Nature which we also realize in our ideals of truth and justice.[1] The 'laws' of mechanism, the 'properties' of elements, &c., are now coming to be regarded as adequate only to describe the average of a host of individual entities. It is becoming recognized that we cannot definitely predict what an individual atom or electron will do next, nor which of the possible jumps of a quantum will occur next. Each single entity is in fact an aggregate of probabilities—having probable mass, probable velocity, probable position, &c. It has been asserted of the electron that at any instant it may be allowed *either* a precise velocity *or* a precise position, but *not both*.

The second law of thermo-dynamics holds only as a mass effect for a huge collocation of individuals. That collocation always contains smaller and more or less mutually independent units, magnitudes, or systems, which are not at the moment illustrating the general law of the running down of the energy of the Universe. The study of Brownian movement shows the non-applicability of this irreversible law of thermo-dynamics when we consider the action of the molecular movements of water on minute particles of solid matter.

So too within the individual living organism, creative as well as destructive powers, both mental and material, manifest themselves. Guidance within Mind and Life and what is called 'chance' action among the individual units of the inorganic Universe may lead temporarily, at least, in one or in the other direction, and thus make prediction of individual conduct impossible.

But surely, 'chance', in the sense of pure 'luck' (in contrast to guiding 'fate' or 'fortune'), is a mere cloak to cover our ignorance of determining conditions: 'accidents' are scientific impossibilities. Our inability to predict the conduct of any organized individual and our ascription

[1] *Theory of Heat* (London: Longmans, Green & Co., 1871), p. 312.

of its conduct to 'chance' or 'accident' arise, as in the fall of dice, merely from our impotence to foretell the precise determining conditions that will be present. This impotence does not necessarily imply the presence of some mysterious *quasi* 'vital' force, which is performing miracles by running counter to mechanical principles. It may merely mean that results can only be foretold after the original event, because we can never know precisely the determining conditions and seldom know the outcome of them in new combination; and that (from the standpoint of meticulous accuracy) history never repeats itself.

Even the acceptance of such a psychological conception as 'guidance directed towards some end' does not imply a denial of the sufficiency of mechanism for Physics in the past. Nor does it necessarily deny that in the realm of Physics, as in the phenomena of volition, of heredity, and of evolution, if all the conditions could be known and had been observed together before, prediction would be certain. What it does suggest is that for Physics, as for Psychology and for Biology, the past is really different from the future, that the future of any organized (or individual) unit is unpredictable, and that the passage from one side of a mathematical equation to the other is strictly and actually irreversible throughout Nature. We may by abstraction display the blindly working *machine* in Evolution. But the machine needs directive *guidance*, whether along already laid rails that predetermine, or by some 'mechanician' that ever selects and adapts, means to ends.

The second law of thermo-dynamics, as commonly understood, involves the assumption that at some remote time the Universe was wound up and set going, since when it has been running down by random movement towards an increasingly unsorted state. This assumption, it is true, the physicist regards as lying outside Physics: if he is bound to assume that the Universe was once wound up for it to be now running down, he bothers no more about the fact. The psychologist, on the other hand—as indeed every evolutionist—sees more in the Universe than this ceaseless process of irreversible degradation. He insists that there

is more in Mind (and suspects that there is more in any organized or individual unit throughout the Universe) than mechanism—that just as a chance shuffle of musical notes or a chance throw of the compositor's type will never satisfactorily account for the production of a musical or a literary masterpiece, so chance variations of the countless components which enter, say, into the bodily forms and into the mental instincts of living organisms can never account for the appearance and evolution of those forms and instincts. 'Conservation of energy' and 'conservation of matter' are important enough principles—whether or not their universality be one day questioned. But at least as fundamental and certain is the psychologist's peculiar principle, 'conservation of self'—or, more generally, conservation of the individual system—which makes for preservation of pattern, endurance of identity, and unity and continuity of the individual throughout its history. Even each of the various individual sub-systems within the 'universe' of the individual mind endeavours to conserve and to assert itself; e.g. impressive memories strive to recur, to intrude—or as the psychologist says, to 'persevere'—in consciousness. The biological 'struggle for existence' is essentially a psychical struggle—an illustration of the 'conservation of self'. The same principle is surely involved in that stereotyping of patterns which is responsible for the permanence and distinctiveness of genera and species throughout animal and vegetable life. May it not also be invoked to account for the distinctive patterns and types of movement and configuration observable throughout the physical, chemical, and stellar world?

Thus the psychologist finds other assumptions—implying pre-adaptation, selection, &c.—necessary to account for past and present happenings. Will the future experimental physicist, in his study of the individual unit, likewise be forced to admit such assumptions, or will he, from his own standpoint, deny that there is any scientific reason for admitting them? If he admits them, will he declare that they are of no more concern for pure Science

than his present assumption that the Universe was once wound up and set going? Or will he, with the rapid widening and individualization of his fields of investigation, find the admission of efficient causes necessary as forming an integral part of his science, although so far he has found neither room nor occasion to invoke them?

Closely allied to the psychologist's conception of the conservation of 'self' is his conception of the conservation of 'nexus'—which may also prove applicable in the physicist's world. When the same two external objects or events, A and B, are repeatedly presented to us in succession, we acquire an association, linkage, or nexus between our experiences of them which we may represent as $a—b$. A psychical integration has occurred, so that $a—b$ now forms a unitary whole, and when A is presented to the subject b tends to be revived. If the acquirement of this association $a—b$ is followed by the acquirement of another association $a—c$ (a and A being common to the two cases), the association $a—b$ seems to disappear; that is to say, when A is presented to the subject c tends to be revived. But $a—b$ is not really annihilated or destroyed by $a—c$. The older nexus is merely inhibited or repressed by the younger one; it tends to return in course of time.

So, too, if we lift first one, then the other, of a pair of canisters of equal size, the second of which has been weighted more heavily than the first, and if we practise repeated lifts of this sequence of light and heavy weights, a condition of 'attunement' is finally established. The result of this attunement is that the second of two *equally* heavy canisters will be lifted with greater force than the first, causing it to be judged lighter than it. The nexus responsible for this attunement can be apparently counteracted by subsequent practice in lifting pairs of canisters in *reverse* order, the first now being heavier than the second. But the same result of apparent counteraction can also be obtained by repeatedly lifting pairs of *equally* weighted canisters. There is therefore no true counterbalance. Moreover, the older nexus is not destroyed, it is merely inhibited by the later nexus. Experiment has proved that,

like the earlier acquired association, the earlier acquired attunement tends to return in course of time and, other things being equal, to outlast the one later acquired.

This inhibition, repression, or repulsion of one acquired disposition by another—this indestructibility of the nexus—is analogous to the more familiar inhibition, repression, or repulsion of one discordant or uncongenial idea by another; what is here repressed is again very far from being inert. Whether such a psychological conception of inhibition as an active repulsive force is applicable to other examples of purely physiological inhibition, or even to purely physical happenings, must be left to the future. The older view of physiological inhibition is that it is due to a passive blocking or exclusion of the inhibited nervous impulses, in which reciprocal struggle and counter-struggle play no part.

Let us turn now to quite another field of psychological experiment which would perhaps have been more suitably considered when we were considering the intensity of sensations, had it not led us too far from the subject then under discussion. We now know that there are two classes of sensations—those whose intensities increase continuously and those whose intensities increase by sudden jumps. The sense organs concerned with the latter class respond by 'all-or-none' changes. For example, the heat and cold spots on the skin are punctuate end-organs, each varying in sensitivity, and hence each requiring a different strength of stimulus to cause it to react. If any one of these end-organs receives too weak a stimulus, it will not respond; if it receives a very strong stimulus, it will not respond more intensively than if it had received a weaker, but nevertheless adequate, stimulus. Each such end-organ either responds with its maximum effect—as if a trigger started always the same explosion—or it does not respond at all. In addition to such 'all-or-none'-responding apparatus, the skin also possesses a 'mechanism' for giving 'continuously graded' sensations of moderate temperature.

It is difficult to resist drawing an analogy between the existence of these two systems of sensibility and the

dilemma concerning the undulatory and corpuscular hypotheses of the transmission of energy with which Physics is now confronted. Both of these hypotheses, it seems, are at present needed to explain all the physical facts; the difficulty is to combine them consistently. The quantum hypothesis is analogous to the 'all-or-none' reaction. According to it, a molecule vibrates in different modes, each mode being a different frequency of vibration. But none of these modes can be excited to any desired grade of intensity. The energy is carried away in units, each mode of vibration having its own particular size of unit. The exciting cause may be strong enough to produce a unit; if it be too weak, it will produce nothing, i.e. no energy at all. Energy is therefore radiated in finite quantities, increasing or decreasing in jumps. How such 'all-or-none' behaviour is to be combined with the 'continuously graded' undulatory behaviour of the ether is at present undetermined. The same problem confronts the physiologist in his study of medullated nerves and of striated muscle, the fibres of both of which similarly respond in the 'all-or-none' fashion, differing among themselves in sensitivity: how is this action consistent with the 'continuously graded' contraction in virtue of which prolonged muscular tone is exhibited? Have we psychologically, physiologically, and physically, in each of the three cases, two distinct sets of apparatus, or does the same apparatus, differently co-ordinated, function now in one way, now in the other?

There are many senses in which the psychologist's statement holds true, that the organized whole is greater than the sum of its parts. Special attention has been paid of late years to what psychologists, imbued with the dangerous desire of founding a 'school', have unfortunately described as a special psychology, the *Gestaltpsychologie*, i.e. the psychology which stresses the importance of shape, form, and order rather than that of 'material' and its abstract localizable parts. As we all know, the same melody may be reproduced in a different key, by using notes that are quite different from those previously employed; or the same notes may be combined afresh to produce a quite

different melody. Further, it is impossible to change one part of an organized whole or to admit a new part into it, without changing the relations, and hence the characters, of the other parts that constitute it. Memories and ideas are dependent for their appearance in consciousness, not merely, as we have already noted, on their own intrusive, intrinsic force, but also on meeting with and conforming to a suitable, favourable constellation so as to be congruous with and congenial to the just vanishing and the just appearing 'patterns' of consciousness. Everywhere throughout Mind, in somewhat different shades of meaning, we can recognize this fundamentally psychological conception that the orderly organized unit is something greater than the sum of its disorderly parts. In actual 'material' the 'individual' is never precisely the same for two consecutive moments, but it is constant in general 'form'. And we can see this conception spreading throughout other sciences.

A further question has to be considered—In what sense does the whole originate from a combination of its parts? The physicist of the past has felt little doubt that first come the elements, and that next appear, from their combination and from successive combinations of combinations, more and more complex compounds. In this way a machine is seen to be constructed out of parts, a new army to be established from conscripts, a new town to arise from settlers. Spencer adopted the same attitude when he wrote that 'organic evolution is primarily the formation of an aggregate, by the continued incorporation of matter previously spread through a wider space'.[1] Psychology, on the other hand, has found it necessary to lay greater stress on differentiation than on integration, as regards their respective roles in Evolution. Biology, too, is coming to adopt the same attitude: it tends no longer to regard the multicellular organism as the product of an aggregation of unicellular organisms. We do not start from simpler independent units which combine and fuse to form a larger, more complex unit. On the contrary, the simpler units

[1] *First Principles*, p. 311.

within the whole have rather been, like the parts of a statue, carved out of an originally vaguer, less differentiated, whole. The multicellular adult develops from a single ovum: the structure and functions of the once primitive whole have become specialized and differentiated among a number of now discrete parts.

Psychology has long insisted on this standpoint. There was a time when, *more physico*, the belief was held that in its mental development the infant first experienced separate elementary 'sensations' of whiteness, softness, warmth, &c., and that by combining these he ultimately obtained the 'perception' of an object, say of its mother's breast. But we now realize that the percept of the whole object is given, with meaning however vague, from the start; that with growing experience it acquires ever fuller meaning; and that from such maturer percepts the so-called 'sensory elements' become differentiated. These sensory elements in their pure form—that is to say, stripped of all meaning save that relating to their quality, intensity, extensity, and the like—are not the first, but among the later, to appear. They are the narrower abstract formations constructed by broad experience. First comes the relatively homogeneous, which already contains within itself the germs of the later heterogeneous.

This conception has also found biological acceptance in the Mendelian study of heredity. The variations exhibited in later species are believed to be determined by a resolution and differentiation of the germinal Mendelian units of the earlier, more homogeneous, species. The elements are, as it were, carved out of the pre-existing and evolving whole; they are not combined to produce it. The future is already contained within the past and present, from which somehow it becomes distilled.

Such 'distillation' accounts probably for the gradual development of consciousness. It has been distilled from originally lower mental levels, from something very different from itself as we know it; and through the privations resulting from such distillations, the lowest of these levels within the living organism has been reduced to the condi-

tion of 'reflexes', almost mechanical, practically void of adaptation to experience. The old view expressed by Spencer, and not yet wholly extinct among biologists, was that consciousness has arisen as an 'epiphenomenal' product of living matter when physiological processes became too complex to work automatically. The modern psychological view is the direct converse of this—namely, that consciousness, however primitive, fulfilling, however feebly, the functions of orderly direction and purpose, is primary, and that it has grown by distillation, differentiation, and restriction to narrower, more dominating, higher levels within the organism. Once again we see the same principle illustrated—that the new is already contained within the old.

No one would be so foolish as to suppose that the new is clearly manifest as such in the old or that integration and co-ordination have not played an important part in Evolution. The questions we have to consider are—how far does the conception of the construction of the heterogeneous out of the homogeneous by differentiation instead of by aggregation and how far does the conception of the simple having been resolved from, instead of combining to form, the complex,—how far do these conceptions deserve consideration in regard to the evolution of the Universe as a whole? If the elements in it are comparable to the notes of a tune or to the words of a language, which came first—the compounds, music and language, or the elements, scales and grammar?

In a book written eighty-six years ago by a physicist who achieved only posthumous distinction, entitled *Thoughts on some Mental Functions*, occurs this striking sentence: 'We are led to expect that if molecular philosophy is ever destined to advance into the region of [biological] organization the phenomena of perceptive consciousness will admit of being applied to illustrate the physical aspect of the elementary process of matter.' 'Organization', this author maintained, 'is to be viewed . . . as a grand exhibition of the capabilities of the elements of matter. . . . It is from molecular adaptations that the amazing monuments

of creative intelligence have emanated.' He ridiculed 'the old system of explaining organic phenomena by mechanical arrangements' without the help of what he called 'molecular adaptations'.

The physicist who in 1843 gave expression to this view, that the phenomena of Mind will one day be employed to throw light on the phenomena of Matter, was John James Waterston, whose works have lately been collected and published, with a memoir, by a distinguished *alumnus* of this University. He was the same Waterston who in 1845 offered a remarkable communication to the Royal Society which rejected and pigeon-holed it, extending what he termed 'molecular philosophy' so as to avoid further use of the old conception of 'caloric'. The neglect of this paper, in which Waterston had the genius and pioneering courage to ascribe heat to molecular motion, retarded the development of the subject, according to the late Lord Rayleigh's estimate, by ten or fifteen years. Waterston also declined to accept the second law of thermo-dynamics, preferring to ascribe the relevant phenomena to the chaotic nature of the molecular movements.

Waterston realized that there was more both in Mind and Nature than merely 'mechanical arrangements'. If the psychologist's conceptions of the part played by direction, guidance, and selection in Mind and in mental evolution are extensible to the evolution of living and celestial bodies, then we must admit the play of some guiding and sorting activity, which is the agent of Evolution. We are compelled to question the sufficiency of Spencer's view that a medley of strains and forces, now fanned, as it were, by a winnow, or now shaken, as it were, in a sieve, can be responsible for all the known forms of differentiation and segregation occurring in the lifeless and in the living world. If we deny a guiding δαίμων, we have to consider why Evolution should occur at all, why the homogeneous should ever develop into the heterogeneous, why primeval stability should decrease, and why complexity should increase in the history of the Universe. Must we not include among our First Principles something

more than general physical laws to account for the evolution, and hence for the history and conduct, of Mind, Life, and the Universe? That 'something' is certainly not 'mental' as we know it, however akin to it; for we must guard against the danger of crude 'psycho-morphism'. Psychology can help only a little in indicating its nature. It can help only a little in stressing the probable coexistence of Guidance and Mechanism. It can perhaps also help in putting forward other conceptions which it has found necessary for its own use in addition to those which it has gained from Biology and Physics. These conceptions it ventures to offer humbly, in its position as the youngest sister Science, for consideration and possibly for ultimate acceptance by the maturer Sciences.

PRINTED IN GREAT BRITAIN AT THE UNIVERSITY PRESS, OXFORD
BY JOHN JOHNSON, PRINTER TO THE UNIVERSITY

OXFORD UNIVERSITY PRESS
AMEN HOUSE, E.C. 4
LONDON EDINBURGH GLASGOW
LEIPZIG NEW YORK TORONTO
MELBOURNE CAPETOWN BOMBAY
CALCUTTA MADRAS SHANGHAI
HUMPHREY MILFORD
PUBLISHER TO THE
UNIVERSITY